

# Model-based face computation

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## Research Goal

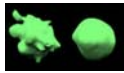
This project learns a face model from 500 human faces and investigates the distribution of face space. Based on this, a few applications are explored:

- **Face inpainting** with local linear representations
- Automatic **caricature** by feature normalization and exaggeration
- Model-based line drawing **portraiture**

## Role in IMSC

- Face inpainting will help improve the performance of face detection and recognition when subjects wear glasses/masks.
- Caricature and portraiture could be applied in virtual worlds for user identity obfuscation - most users don't want to expose their real identity online.

## Research Approach



From 500 faces we learn a distribution of human face space, and discover that it has a non-Gaussian distribution (left). The three dimensions we select are width of left eye, nose, and mouth.

Because face space is non-Gaussian, global representations may not always produce best predictions. Thus, we use a local linear representation to achieve better performance. Statistic properties are better revealed while rejecting outliers.



For automatic portraiture, we use a prior model of the face to locate and emphasize important face features and de-emphasize unimportant details. This model-based method enables the generation of attractive line renderings of faces while offering a range of stylization and simplification possibilities.

We locate salient features of a face by comparing it to the mean and variance of a population. Caricatures can be automatically produced by further exaggerating these features.



## Accomplishments

- Face inpainting with better accuracy

	Mean Error Nearest Neighbor	Mean Error Global Fit	Mean Error Local Fit	Local Best Percentage Case
Noise	6.67%	1.19%	0.47%	74.0%
Noise	5.79%	1.16%	0.43%	70.5%
Eyes	10.62%	1.36%	0.88%	67.5%

- Better caricature and portraiture results

- Publications

- Improved Automatic Caricature by Feature Normalization and Exaggeration, Proc. of the ACM SIGGRAPH 2004 Conference on Sketches & Applications, Los Angeles, 2004
- Face Inpainting with Local Linear Representations. Submitted.
- Model-Based Stylization and Abstraction for Line Drawing Portraiture. Submitted.

## Uniqueness & Related Work

- We are the first to discover that human face space has a non-Gaussian distribution.
- We are the first to use a model-based method to render human faces as line drawings. We distinguish our method from image-based or example-based method by better results and a wider range of stylization possibilities.
- We are the first to take both mean value and variations into consideration while doing feature exaggeration to produce caricatures.

## 5-Year Plan

- Extend two dimensional caricature into three dimensional caricature; explore techniques for caricaturing expressions.
- Implementation of a more robust portraiture system which is capable of dealing with fancy hair styles, beard, glasses, etc.